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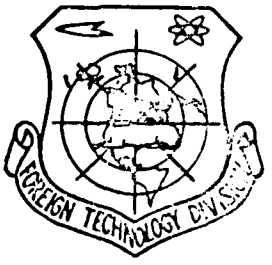
FOREIGN TECHNOLOGY DIVISION

MIG JETS

by

Piotr Butowski



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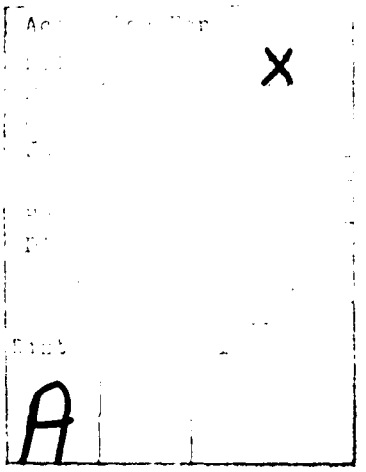


MIG JETS

Piotr Butowski

With the aim of accelerating the construction of the new, very promising AM-5 engine, in 1951, Mikojan decided to test two of them in a series MiG-17, mounting them side-by-side in the rear portion of the fuselage. This new experimental aircraft initiated the work program on the first supersonic fighter of the MiG group which was designated by the cryptonym SM and called the I-340 (or also SM-1, the first variant of the SM program). An I-350 aircraft (cryptonym M) with one TR-3A engine was tested at the same time as the I-340. It received wings with a significantly greater sweep than previous MiGs, an elongated fuselage and four flow fences were used on the upper surface of the wings.

The first flight of the I-350 (M) was conducted 16 April 1951 by veteran test pilot G. Siedov. However, the engine flamed-out during the flight and only thanks to the expertise of the pilot was the landing successful. Only five flights were made by the aircraft due to constant problems with the TR-3A engine: sufficient information had been attained and further flights with this unrefined engine were too risky. The best fetures of the I-340 (SM-1) and the I-350 (M) were used in the subsequent construction of the I-360 (SM-2): the propulsion unit of the SM-1 and the general construction concept of the I-350. The high-mounted horizontal tail-plane was characteristic for

the SM-2. The flight testing of several copies of the SM-2 lasted quite awhile. They started 27 May 1952 and continued throughout 1953. Howevever, the AM-5 engine did not assure flight at supersonic speeds and it was only after the application of the AM-5A engine with afterburner that a speed of 1192 km/h was attained. In the successive SM-3 aircraft the single high-thrust engine was returned to. The next experimental fighter-interceptor, the I-370 (I-1), received the same propulsion, however, great success was achieved by an aircraft with two RD-9 (AM-9) engines mounted side-by-side in the rear portion of the fuselage. This aircraft was put into series production under the name MiG-19. This was the first series supersonic fighter in the USSR. The SM-7 interceptor variant also emerged. However, these first versions were not too successful. Only after the introduction of a laminated tail-plane on the MiG-19 did the SM-9 appear which was test flown 5 January 1954 and delivered to the military 31 August 1955 under the designation MiG-19S. This version was built in great numbers and remained the most popular version of all MiG-19's.

The MiG-19S was continuously updated. The high-altitude fighter MiG-19SW, the two-seat trainer MiG-19UTI, as well as the MiG-19R reconnaissance variant came into being. The further development of design proceeded mainly in the direction of the modernization of armament. Thanks to the RP-5 radar, the MiG-19P (perechwatczik [interceptor]) and the MiG-19PF (forsirowanny [increased power]) versions were developed. Although it was necessary to remove one cannon to maintain stability of the aircraft, the value of the combat fighter grew. Radar permitted the fighter to operate day and night in every kind of weather condition. A further series version was the MiG-19PM (M for modified) which was armed exclusively with missiles. The wingroot cannons were removed and in their place the aircraft was equipped with four K-5 air-to-air guided missiles which were directed by an onboard radar set. There were also the MiG-19PG and MiG-19PML fighter-interceptor versions.

Many versions of the MiG-19 were compiled that never went into

series production. Several copies of the SM-10 appeared in 1955. This was a fighter adapted for air refueling which had a properly shaped fuel input located either at the end of the left wing or on the forepart of the fuselage. The SM-30 was a fighter launched from a movable catapult which came into being in 1956. Five copies of it were built. Next, the SM-50 (MiG-19SU), a variant of the MiG-19S with a supplemental U-19 rocket engine, appeared in 1959 which attained a speed of 1800 km/h.

From 1960 on, MiG-19 aircraft were used by the national air forces of the Warsaw Pact, Arab countries, China, Pakistan and others. The MiG-19S was built under license in Czechoslovakia as the S-105 and the versions produced in China were the MiG-19S (called the F-6 in the East) and the MiG-19P (called the F-7). A further development of the MiG-19, the F-9, also appeared there.

The P and PM versions of the MiG-19 appeared in Poland about 1960. This was our first supersonic aircraft. These aircraft were from service with the LWP [Polish People's Army] at the beginning of the 70's, but several copies are retained in museums and on monuments.

Production of the MiG-19 had not even begun when on 14 February 1954, G. Mossolov [spelling from Jane's] test flew the E-2 aircraft, this being the first try-out of the subsequently fanous MiG-21 fighter. This was a light swept-wing fighter, powered by a single RD-9 engine and armed with two 30 mm cannons. The aircraft which differed from the E-2 only in the shape of the wings was the delta winged E-4 which appeared in 1955 and was test flown by G. Siedov 14 June 1956. However, neither of these aircraft were successful primarilly due to the lack of a sufficiently powerful engine. In 1955 they attempted to overcome this problem by building the swept-wing E-50 which received the combined propulsive arrangement of an RD-9E turbojet engine and an S-155 rocket engine. In spite of a speed of 2460 km/h, the E-50 was not able to become a model for a series fighter: the great fuel comsumption of the rocket engine caused the range to be decreased to 450 km. The solution was not reached until a year

later when the team of S. Tumanski built the light and effective R-11 engine. Replacing the RD-9 with the R-11 in the E-2, E-4 and E-50 aircraft brought about the E-2A, E-5 and E-50A respectively. In spite of its weight, speed and ceiling, the range of the E-50A was too short. A total of 12 E-50 and E-50A aircraft were built. The choice of a future fighter had to be made between the E-2A and the E-5, differing only in the shape of the wing. The E-2A had swept wings while the E-5 had delta wings. V. Niefiodov test flew both aircraft and both were shown publicly during a fly-by near Moscow in July 1956. After comprehensive tests, it was decided to develop the prototype E-5, producing only a short series of 30 copies of the E-2A. One of the greatest problems was the construction of a controllable air intake for the new fighter. Tests of various solutions were conducted on the SM-12 aircraft, a further development of the MiG-19, as well as on further developments, the SM-12PM and SM-12 PMU. The final preseries variant E-6 appeared in 1958. It was delta winged, powered by an R-11F-300 engine and armed with two air-to-air guided missiles and two NR-30 cannons. A characteristic feature of the E-6 was three flow fences on the upper surface of the wing. On 31 October 1959, Mossolov established a world speed record of 2388 km/h over a 15/25 km course with one of the E-6 variants designated the E-66. Another world record was the altitude of 34,714 m, attained by the E-66A variant equipped with a U-2 auxillary rocket engine. In 1959, the E-6T aircraft appeared which was series produced and designated the MiG-21F. Many series productions of this fighter were produced, of which the most known is the MiG-21F-13 (or aircraft 74). The two-place MiG-21UTI has also been produced since 1963. At the end of the 50's, many Soviet stratigic bombers were modified to heavy jet missile carriers. These aircraft missiles, having a weight of about 10,000 kg, were built by the A.I Mikojan team for the Tu-95 system. This was a pilotless flying device with slender swept wings and a slim fuselage which attained a high supersonic speed.

Parallel with the E-5 and E-6 front-line fighters, the fighter interceptors I-3 (in versions I-3P and I-3U, or I-380), I-7 (in versions I-7K, D, P and U), as well as the I-75F appeared. These AL-7 powered aircraft with both swept and delta wings, were designed by

A. Lulka. These were not series produced because simultaneously, the Su-9 and Su-11 appeared which were parallelly designed by Sukoj.

However, Milojan never abandoned thoughts of an automated fast fighter-interceptor equipped with long-range guided missiles and intended for combating supersonic bonbers. Many such aircraft appeared between 1958 and 1960. The first of them was the E-150 which was equipped with an automized intercept system, attained a speed of 3000 km/h and was armed with two K-9 or K-9 heavy rockeds. It was propelled by a single R-15 engine having a thrust of 91.2 kN. Other developments were the E-152 with a slightly different armament system, a more powerful R-15A engine (thrust 98.1 kN) and trapezial wings, and in addition, the E-152A in which the single R-15 engine was replaced by two R-11 engines. The E-152A was introduced in a fly-by near Moscow in June 1961. The last aircraft in this series was the E-152M. This aircraft established many world flight records, among others, in 1962, G. Mossolov attained the speed of 2681 km/h and P. Ostapienko reached an altitude of 22,670 m. In documentation of the record, the aircraft was renamed the E-166, thereby creating the tradition of two sixes.

After the beginning of series production in 1959 of the MiG-21F, its development naturally continued. Already in 1960, the prototype E-7 (aircraft 75) had appeared with improved aerodynamic, but most importantly, a radar. It received the military designation MiG-21PF after production started. In 1961, the E-7 was introduced publicly for the first time. Further design changes were introduced in subsequent versions: the aerodynamic properties were improved, the pilot's canopy was changed and the cannon armament was removed. The MiG-21PF, PFS and PFM versions constitute the so-called second generation of the MiG-21. The MiG-21M, MF, bis and others are the third generation. They received more sumptuous equipment, modern engines and increased armament (four underwing attachment points and a twin-barreled cannon under the fuselage). These versions, aircraft 94, 95, and 96 among others, can be used as attack fighters. The reconnaissance MiG-21R, as well as the combat trainers MiG-21U, US and UM

are among the series versions.

For many years, the MiG-21 was the primary aircraft of the USSR Air Force, socialistic countries and also other nations. The first MiG-21 appeared in Poland at the beginning of the 60's. Our air force is still using aircraft from all three generations.

Several very strange experimental versions of the MiG-21 also appeared. In 1962, Mossolov test flew the E-8 prototype in which the air intake was moved to the underfuselage of the aircraft and small vanes were added in front improving the take-off and landing properties. Similar vanes were also tested on the MiG-21I. The MiG-21Sz attack version received side intakes and was armed with a cannon which was movable in the vertical plane. In 1967, the MiG-21DPD (dopolnitielnyje podjomnyje dwigatieli [auxillary lift engines]) with a take-off run shortened to about 200 m was denonstrated. During work on a supersonic passenger aircraft, the A-144 analogue aircraft appeared which was based on the MiG-21 and had the wing of the future Tu-144. It was used to study the characteristics of this new type wing as well as for pilot training.

The MiG-21 had barely entered into the air force inventory when, after abandoning the development of the E-150 and E-152, Mikojan decided to develope a heavy fighter-interceptor under a completely different concept. The project amazed its innovator. Not everyone on the Mikojan team was convinced about this project. A. Brunov, a long time collegue of Mikoyan, refused to lead the work on the new aircraft. The designer directing the project was initially M. Gurevich, and next, after his retirement in 1964, N. Matiuk. The most characteristic trait of the new fighter was to be the capability of prolonged flight at a responding speed of Mach level 3. Its composition demanded great effort by many USSR industrial branches, mainly metalurgical and electronic.

The world first heard about the new aircraft in 1965: the designation E-266 appeared in FAI record reports. Shortly thereafter,

the Soviet press gave the military designation MiG-25 for this aircraft. It is a twin-engined, high-wing monoplane with a characteristic double vertical tailplane. It is the fastest series fighter in the world and it is armed with four heavy air-to-air missiles of great range. It is anticipated to operate at high altitudes (the service ceiling exceeds 25 km and the zoom ceiling exceeds 37 km). Record results show that the MiG-25 is able to take-off and climb to an altitude of 25 km in 2.5 minutes. In the latter part of the 60's, the MiG-25 entered service in the Soviet Air Force. Nine pre-series copies were publicly demonstrated during the 9 July 1967 fly-by at Domodedovo. The MiG-25 is employed in several interceptor versions (with different armament systems), reconnaissance versions (with electronic, photographic and other equipment), as well as in a combat trainer version. The first series series was equipped with P-266 engines with a thrust of 110 kN. later series (for example the record E-266M) were equipped with two engines with a thrust of 140 kN.

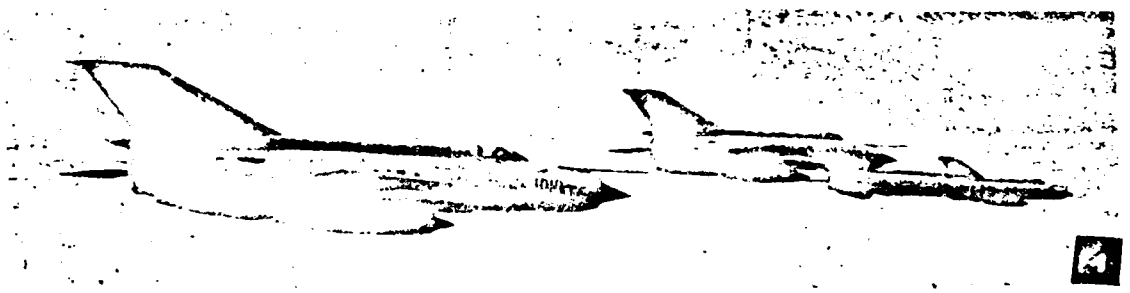
In the beginning of the 60's, several test aircraft were developed given the common designation MiG-23. Each of them represented a different aerodynamic concept. Among others built was the MiG-23DPD which had a delta wing, side air intakes and in addition, auxilary take-off engines located vertically inside the fuselage. The short take-off was demonstrated by P. Ostapienko 9 July 1967 at Domodedovo. However, none of this type construction were entered into series production. An aircraft with variable-geometry wings, test flown in 1967, became the series MiG-23. The first series version of the MiG-23 greatly resembled the prototype introduced at Domodedovo, however, it was not built long. The basic version, built in great numbers, was the MiG-23M on which the wing shape was changed slightly and in addition, the new R-29 engine with a thrust of over 100 kN was used. The MiG-23M is built in several versions with different equipment and armament. Successive versions are the frontal reconnaissance aircraft, as well as the MiG-23U, a two-seat combat trainer. It was also decided to adapt the MiG-23 to attack ground targets. In the fighter-bomber variant, the unnecessary radar gun sight was removed in order to shorten the front of the aircraft and

thus improve the visibility from the cockpit.

Still further reaching changes incorporated into subsequent fighter-bomber versions resulted in the MiG-27, a new aircraft. Most important were the strengthened construction and an engine modified for low-altitude flight. The high-speed flight characteristic was relinquished which is of secondary importance in this case. The fuselage is shaped in accordance with the principle of area rule. The aircraft can operate from a field strip (low-pressure landing gear and a higher rise of the rear portion of the fuselage). The guns, effective against ground targets, were improved: the twin-barreled cannon from the MiG-23 was replaced by a six-barreled cannon in the MiG-27.

The MiG-23 entered in the Soviet Air Force inventory almost 10 years ago. Today several versions of the MiG-23 aircraft are in use by the air forces of Czechoslovakia, the German Democratic Republic, Hungary, Cuba and many other countries.

After the death of Artiom Mikojan in 1970, the design bureau received his name and under the direction of Rostislav Bielakov (born 1919), works on the most modern combat aircraft which will, as in the past, receive the symbol MiG.



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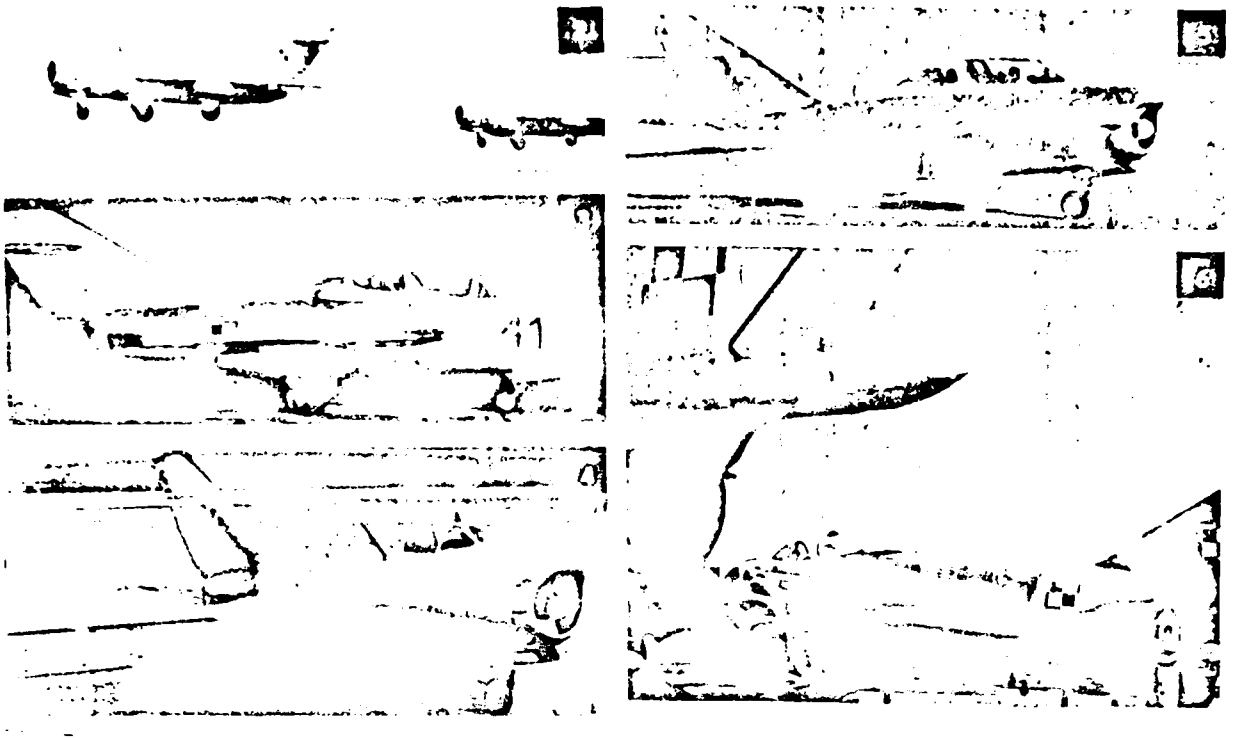

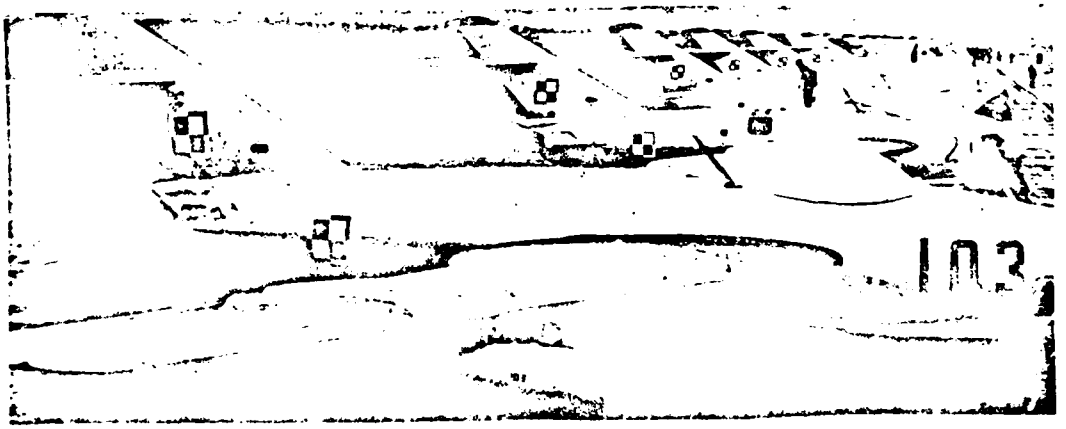

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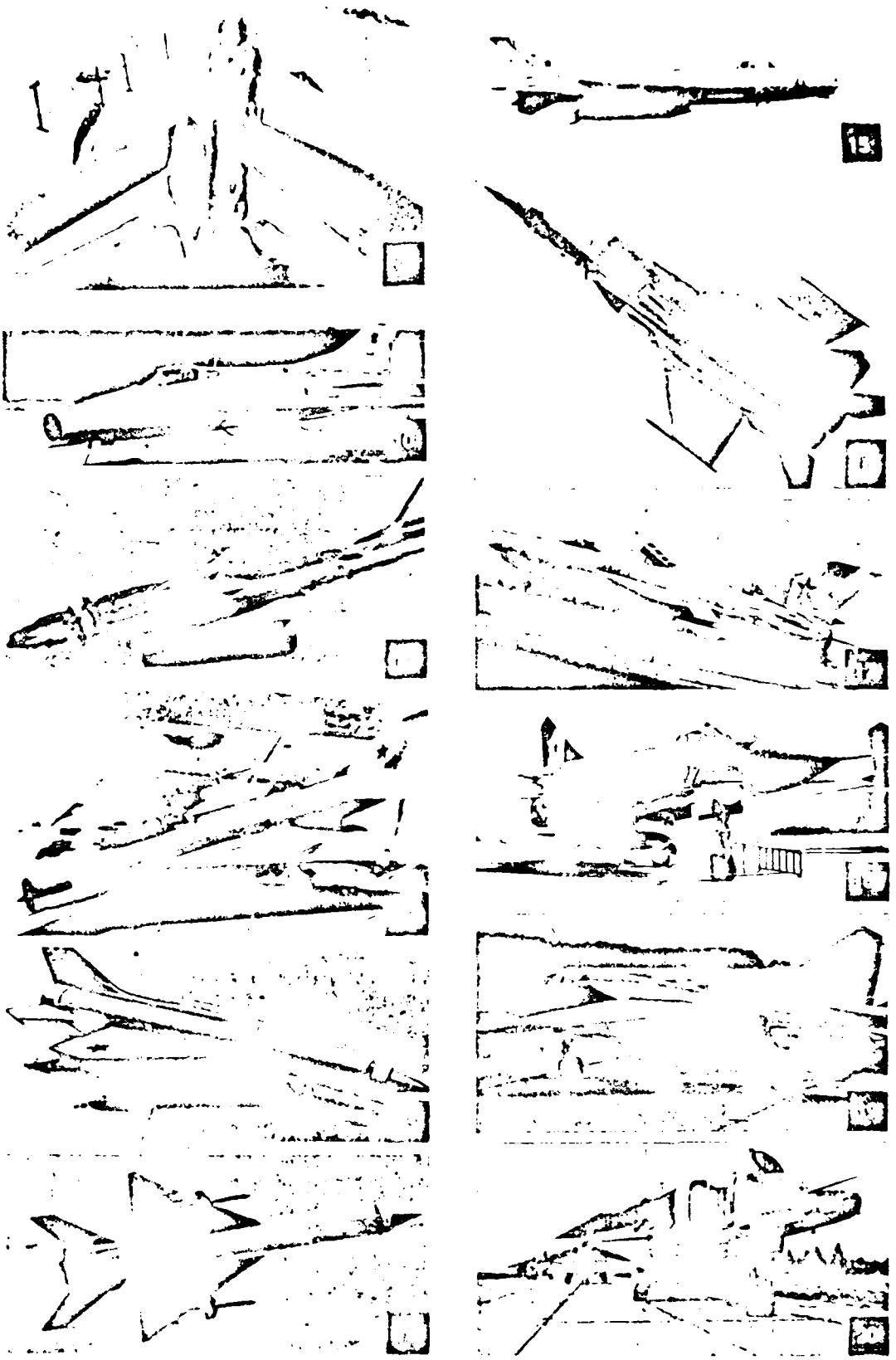


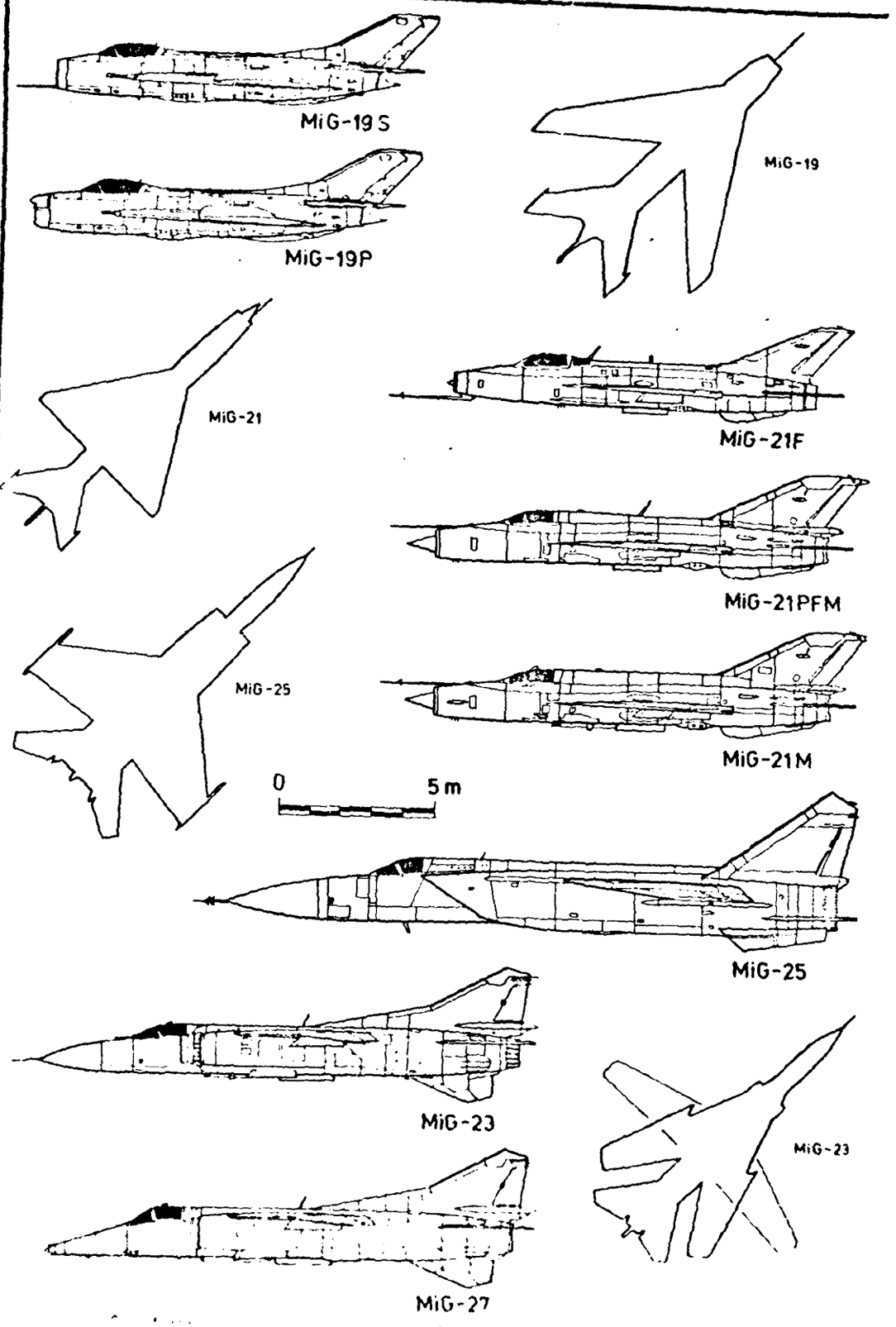
[Photo legend page 11]

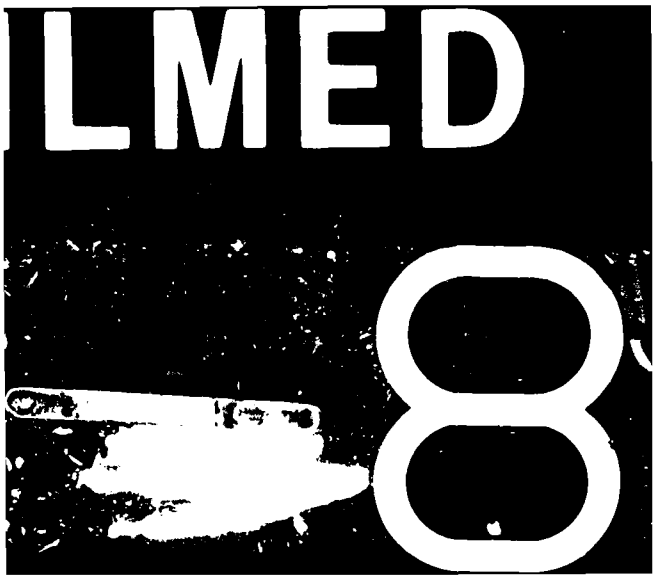
Photo legend:

1. MiG-21's with Polish Air Force markings. Photo: L. Zielaskowski
2. MiG-15's. Photo: WAF [Wojskowa Agencja Fotograficzna - Military Photographic Agency]
3. MiG-15UTI.
4. MiG-15 (SP-5).
5. MiG-15UTI-P (ST-7).
6. LIM-6. Photo: WAF
7. MiG-17F's. Photo: WAF
8. MiG-21 on the airfield. Photo: L. Zielaskowski
10. E-50A.
11. Tu-95 and MiG aircraft missile.
12. I-3U (I-380).
13. E-152.
14. E-152A.
15. E-66A.
16. MiG-25.
17. MiG-21DPD.
18. MiG-23 fighter version.
19. MiG-23 fighter-bomber version.
20. MiG-27.

Typ (1)	Rok (2)	Silniki (3) Ilość (3a)	Typ (3b)	Ciąg (3c) (kN)	Długość (m) (4)	Rozpiętość (m) (5)	Masa startowa (kg) (6)	Prędkość maksymalna (km/h) (7)	Pułap praktyczny (m) (8)	Zasięg (km) (9)
MiG-19S	1955	2	RD-9B	31,9	12,54	9,0	8 660	1 454	17 500	2 200
MiG-19PM	"	2	RD-9B	31,9	13,025	9,0	9 400	1 445	16 800	1 910
SM-30	1955	2	RD-9	25,5	11,33	9,0	7 400	1 200	17 500	2 210
E-50A	1956	+1	+RD-11	+52,0	"	"	8 300	2 600	27 000	"
		1	S-155	39,2	"	"				
E-2A	1956	1	RD-11	50,0	"	"	6 250	1 900	18 000	2 000
E-5	1956	1	RD-11	50,0	"	"	"	2 000	18 000	1 400
I-380 (I-3U)	"	1	WK-3	82,4	16,73	9,3	10 000	1 960	13 000	1 800
I-7K	"	1	AL-7F	91,2	"	"	10 700	2 500	22 500	1 800
I-75F	1957	1	AL-7F	82,4	16,96	9,97	11 380	2 300	21 000	2 000
MiG-21F	1958	1	R-11F	53,9	15,76	7,15	7 370	2 125	19 000	1 670
E-150	1958	1	R-15	91,2	"	✓	"	3 000	25 000	1 500
E-152A	1959	2	R-11F	53,9	19,8	8,97	"	2 500	21 000	2 300
MiG-21 PFM	"	1	R-11F2S	60,8	14,50	7,15	8 300	2 175	19 000	1 670
MiG-23***	"	1	R-29	120	16,8	8—14	20 000	2 500	18 000	3 000
MiG-25***	"	2	R-266	110—140	21,0	14,0	35 000	3 300	23 000	"

Key: (1) Type, (2) Year, (3) Engines, (3a) Number, (3b) Type, (3c) Thrust, (4) Length, (5) Wing span, (6) Take-off weight, (7) Maximum speed, (8) Service ceiling, (9) Range (*) Data approximate


MiG-19S
MiG-19
MiG-19P
MiG-21
MiG-21F
MiG-21PFM
MiG-25
MiG-21M
0
5 m
MiG-25
MiG-23
MiG-23
MiG-27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